Supplement 1_14_08

Note Title 1/14/2008

Sketch of Schröding

Experiments such as electron diffraction suggested particles had wave-like properties. Hence de Broglies

$$\lambda = h/p \quad \text{or} \quad \vec{k} = \vec{p}/\hbar$$

The simplest case to consider is a part. with a well defined momentum as a plane wave:

$$\psi(\vec{r}, t) = \psi_0 e^{i(\vec{k}\cdot\vec{r} - \omega t)}$$

since $\vec{k} = \vec{p}/\hbar$ de Broglie

and $\hbar\omega = E$ Einstein

$= p^2/2m$ for free particle

becomes $\psi(\vec{r}, t) = \psi_0 e^{i(\vec{p}\cdot\vec{r} - Et)/\hbar}$

with $E = p^2/2m$

You can easily show that

satisfies $i\hbar \frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi$

$$\psi(\vec{r},t) = \psi_0 e^{i(\vec{p}\cdot\vec{r} - Et)/\hbar}$$

$$\nabla^2 \psi = \frac{i^2}{\hbar^2} p^2 \psi = -\frac{2mE}{\hbar^2} \psi$$

so $$-\frac{\hbar^2}{2m}\nabla^2 \psi = E\psi$$ ✓

$$i\hbar \frac{\partial \psi}{\partial t} = i\hbar \left(-\frac{iE}{\hbar}\right)\psi = E\psi$$